AF/3726
#17 Reply Brief
Bentley 2/21/04

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE HONORABLE BOARD OF PATENT APPEALS AND INTERFERENCES

In re the Application of:

Alexander Jan Carel DE VRIES et al. Group Art Unit: 3726

Application No.: 10/080,714 Examiner: T. Nguyen

Filed: February 25, 2002 Docket No.: 105531.01

For: METHOD OF MANUFACTURING A ROLLING ELEMENT BEARING WITH IMPROVED ROLLING CONTACT SURFACES

REPLY BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The following remarks are directed to the new points of argument raised in the Examiner's Answer dated September 30, 2003, and reflect changes to the claims made in the attached Amendment After Final Rejection Under 37 CFR §1.116, entry of which is respectfully requested.

I. INTRODUCTION

A. Status of Claims

Claims 1 and 4-6 are currently pending, stand rejected and are being appealed. The attached Amendment cancels claim 2, which has been placed into independent claim 1. Claims 1 and 4-6 are set forth in the attached replacement Appendix of Claims. Claim 1 is an independent claim.

B. Status of Amendments

The Amendment filed on November 27, 2002 is the last Amendment which has been entered. Claim 3 was canceled and claims 1 and 5 amended. However, attached herewith is an Amendment After Final Rejection filed concurrently herewith for entry. The Amendment After Final Rejection simplifies issues for appeal by placing the features of claim 2 into independent claim 1 and canceling claim 2. Entry of the Amendment is respectfully requested.

II. EXAMINER'S CHANGED POSITION IN CURRENT REJECTIONS

A. Claims 1, 4 and 6 are not Obvious from Toru and Miyasaka

Claims 1, 4 and 6 stand rejected under 35 U.S.C. §102(a) over JP 04321816 to Toru in view of U.S. Patent No. 5,592,840 to Miyasaka.

The Examiner continues to admit that Toru fails to teach a method of shot peening to form the recesses. The Examiner also admits that Toru fails to teach formation of recesses to have an average angle α between a recess wall and the surface of less than 5° as claimed.

To make up for this acknowledged deficiency, the Examiner asserts that these features would have been obvious from the teachings of Miyasaka. However, the Examiner's position has changed from the Final Rejection.

Previously, the Office Action admitted that Miyasaka is silent as to the 5° angle feature, and instead relied on the position that "it would have been obvious, if not already, to one having ordinary skill in the art at the time the invention was made to have set the average angle at a specific value as claimed since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art and it would appear that the average angle such as the one in Miyasaka would perform equally as well." See page 3, 1st full paragraph of the Final Rejection.

Now, however, the Examiner attempts to achieve the claimed 5° angle recitation by noting that Miyasaka (col. 2, lines 60-65) discloses shot having a diameter of 20-200 micrometers and a recess depth of 1.2 micrometer or smaller (col. 9, lines 5-10). From this, the Examiner states that Miyasaka "appears" to have angles less than 5°. This new interpretation of Miyasaka must fail.

The Examiner impermissibly relies on the size of the shot to equate to a resultant recess diameter. However, this must fail since it completely contradicts an express teaching in Miyasaka on col. 3, lines 30-36 the desirability of forming recesses with a diameter of between 0.1-5μm.

Thus, although large shot may be used, the resultant recesses are much smaller. Given the express depth of 0.1μm or larger, one of ordinary skill in the art would not have been taught to achieve the claimed large diameter recesses with shallow wall angles of less than 5°. Thus, the Examiner's reliance on shot size as an indicator of resultant recess diameter in the Examiner's Answer is completely erroneous and contrary to express teachings, given the express recitation of a preferred range (.1-5μm) of recess diameter in Miyasaka.

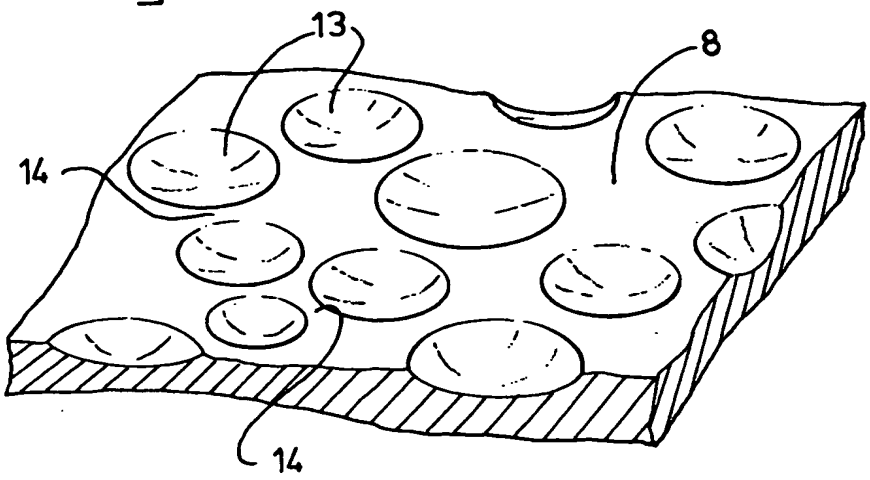
Motivation for such an exaggerated view of the teachings of Miyasaka could only come through hindsight consideration of Applicants' specification since the Miyasaka specification is silent as to the specific resultant geometry of the recess and instead only generalizes that the recesses should be of a circular arc-shaped cross-section. Col. 3, lines 30-46 and col. 7, lines 10-25. This is taught to allow formation of oil droplets in the recesses. However, Figs. 3-4 show actual magnified photographic details in which the recesses appear overlapping and show angled side walls with much more than the claimed 5° angle.

Thus, Applicants respectfully believe that the Examiner is impermissibly relying on hindsight consideration of Applicants' specification in making this rejection and has failed to meet his burden of making a prima facie case of obviousness.

In particular, neither Toru nor Miyasaka teach, suggest, or render obvious all of the features recited in independent claim 1. In particular, none of the applied references teach or suggest a method of forming the recesses by shot peening at least one of its surfaces, wherein an average angle α between a wall of each recess on the at least one surface is less than 5° and the recess has a diameter of between 14-100μm.

The invention achieves improvements in fatigue strength and lubrication by a method of manufacture in which "at least one of the rolling surfaces and the raceways is provided with a topography comprising recesses which are generally isolated from each other by lands and which may contain a lubricant." Applicants' ¶[0013]. The recesses are formed with an average angle α defined by the intersection of the wall of the recess and an adjacent land of less than 5°. Applicants' ¶[0004] and [0020]. Moreover, the recesses are formed to have a maximum diameter of 100 μm and a minimum diameter of 14 μm. This is achieved by a process of shot peening of the surface.

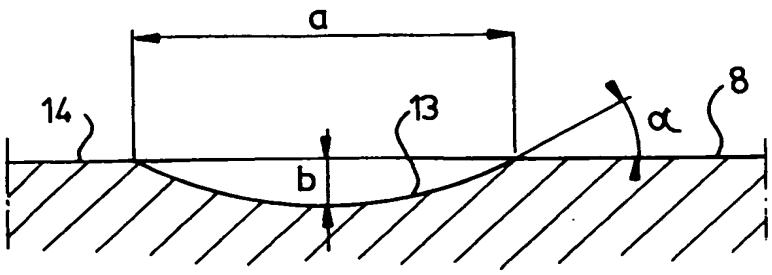
Fig-2



As shown in Applicant's Fig. 2, the recesses 13 constitute small pockets in which oil may be trapped. The recesses are generally isolated from each other by lands 14. When a rolling element overrolls with the recesses 13, they become somewhat compressed, whereby the oil is expelled to achieve better lubrication. ¶[0020]. That is, this flattening causes an extra amount of lubricant to be expelled and fed into the contacting surfaces as an elasto-hydrodynamic lubricating film to separate the rolling surfaces.

Applicants believe that the geometry of the recess is of importance in obtaining good lubricating film for roller bearings at low speeds. In particular, it has been found advantageous to have the average angle α of less than 5°, preferably less than 2° to improve lubrication and improve fatigue life properties. See Applicants' [0007-0008]. See Applicants' Fig. 3 reproduced below.

Fig-3



Toru is absolutely silent about any of the recesses having an angle, let alone the recited range of less than 5°. As such, Toru fails to recognize any criticality to the recess size, and in particular to the angular configuration of the recess' side wall and diameter. Because Toru fails to appreciate the problems overcome by the claimed invention and fails to appreciate the relationship the recess sidewall angle has on the resultant oil lubricating film formation or on fatigue life properties, there would have been no reasonable expectation of success for one of ordinary skill in the art to have experimented with different recess forming methods and resultant different structures.

The Office Action properly recognizes that experimentation by one of ordinary skill in the art is not "routine" unless a "result-effective variable" is first found in the prior art teachings. Because the Office Action fails to identify any teaching in Toru that would have enabled one of ordinary skill to recognize a result-effective variable, the asserted modifications are more than mere the alleged "routine experimentation" since they would be speculative at best. Moreover, the mere fact that the teachings could be modified does not make the modification obvious unless the prior art teaches the desirability of the

modification. In this case, the combined teachings, if anything, teach against the claimed invention.

Miyasaka fails to cure the deficiencies of Toru discussed above with respect to claim 1. The Examiner apparently concedes that a resultant-effective variable is also lacking in Miyasaka since he now relies on the above in an attempt to meet the less than 5° limitation. However, this cannot be met. Moreover, the recess diameter of between 14-100μm also cannot be met in light of express recitation in Miyasaka to use a range of 0.1-5μm, which is substantially lower.

Furthermore, it is not even believed that there is motivation to combine Miyasaka with Toru. Miyasaka discloses shot-peening a surface of a sliding portion of a metal-product. See, e.g., the Abstract of Miyasaka. One of ordinary skill in the rolling bearing art would have understood that a sliding action is not the phenomenon which is of importance in a rolling bearing; to the contrary, it is the ability to roll. That is because the problems which occur in a rolling element bearing are quite different from the problems which occur in a sliding bearing. For instance, in sliding bearings fatigue does not play a role. Further, no concentrated loads occur due to the fact that the surfaces of a sliding bearing are in sliding contact with each other over a large surface area.

In the roller bearings art, however, there is a drastic difference between the limited area of contact between a ball or roller, and the rest of the area which does not have such contact. Thus, the surfaces of the components of a roller element bearing are subjected to largely varying forces, which lead to fatigue problems. Moreover, the stresses which occur in a rolling element bearing are much higher than those which occur in a plain (sliding) bearing.

Thus, one skilled in the art who was devising a rolling bearing element such as in Toru would not have looked to the disclosure of Miyasaka, which primarily relates to providing recesses only on sliding surfaces. Thus, although roller bearings are provided as

examples in Miyasaka (See Table 2-1), the shot-peening process is only performed on a sliding portion of the needle roller. See col. 3, lines 13-17 and col. 9, lines 57-64. It is assumed that actual roller surfaces remain smooth in Miyasaka.

One skilled in the art would have also understood that a "smooth" surface has favorable fatigue properties. Thus, the formation of indentations in a rolling element bearing surface (with the goal of containing oil), goes at the expense of fatigue properties thereof.

Thus, because of the express reference in Miyasaka to apply its process to a sliding surface, Miyasaka teaches away from its combination with Toru to provide recesses on a rolling surface.

With respect to the diameter range of 14-100μm claimed, the Examiner's Answer continues to rely on "routine experimentation" for this omission. However, as admitted, experimentation has long been held to be other than routine unless a "result-effective variable" is first determined by the prior art such that optimization can be routinely determined. No such result-effective variable has been established in either applied reference. Moreover, Miyasaka teaches away from the claimed diameter range by specifying a diameter range of 0.1 - 5μm that is substantially smaller than claimed. When read "as a whole," this teaches away from the claimed combination of features (diameter plus angle plus others) recited in claim 1. Further, because the Office Action fails to identify any teaching in Toru or Miyasaka that would have enabled one of ordinary skill to recognize a result-effective variable, the asserted modifications are more than mere "routine experimentation" since they would be speculative at best.

Accordingly, claim 1 is not obvious from Toru or Miyasaka even if combined. The applied references also fail to anticipate the subject matter of dependent claims 4 and 6, which depend from claim 1 and are allowable for their dependence on claim 1 and for the additional features recited therein.

Withdrawal of the rejection under 35 U.S.C. §103(a) is therefore respectfully solicited.

B. Claim 5 is not Obvious from Toru in view of Miyasaka

Claim 5 stands rejected under 35 U.S.C. §102(a) over JP 04321816 to Toru in view of U.S. Patent No. 5,592,840 to Miyasaka.

The Examiner's position regarding claim 5 remains unchanged. As discussed above, both Toru and Miyasaka fail to teach or suggest the recited 5° angle feature, the diameter range of 14-100μm, or that such a sidewall angle is a result-effective variable. As such, the invention is not obvious. Moreover, even though Miyasaka teaches using glass beads up to 200 micrometers in size, he fails to teach use of such a bead to form the recited angular sidewall feature. As such, dependent claim 5 is not obvious from Toru and/or Miyasaka since each and every feature of claim 5 is not met by the combination. Withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully solicited.

III. CONCLUSION

For at least the reasons discussed above, it is respectfully submitted that Claims 1, and 4-6 contain patentable subject matter and are distinguishable from the teachings of Toru and Miyasaka.

Appellant respectfully requests this Honorable Board to reverse the final rejection of the claims and return the application to the Examiner to pass this case to issue.

Respectfully submitted,

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Enclosure:
Appendix of Claims 1 and 4-6

Date: December 1, 2003

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DEPOSIT ACCOUNT USE AUTHORIZATION
Please grant any extension necessary for entry;
Charge any fee due to our Deposit Account No. 15-0461

APPENDIX OF CLAIMS

Current Claims:

1. (Currently Amended) A method of manufacturing a roller element bearing comprising an inner ring, an outer ring, and a series of rolling elements, a rolling surface of each rolling element in contact with a raceway surface formed in each of the inner and the outer rings, at least one of the raceway surfaces of the inner and outer rings and the rolling surfaces of the rolling elements being provided with a topography comprising recesses which are generally isolated by lands, the method comprising:

forming the recesses by shot peening the at least one of the surfaces to have a maximum diameter of 100 micrometers and a minimum diameter of 14 micrometers,

wherein an average angle α between a wall of each recess on the at least one surface is less than 5 degrees.

4. (Original) The method of claim 1, further comprising using glass beads to do the shot peening.

5. (Previously Presented) The method according to claim 4, wherein the diameter of each glass bead is about 200 micrometers.

6. (Previously Presented) The method of claim 1, further comprising providing the recesses with lubricant.